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An alternative surgical technique for varicoceles: a preliminary experience of the microsurgical spermatic (distal end)-inferior or superficial epigastric vein anastomosis in symptomatic varicoceles associated with perineal pain

Zi Wan[1,*], Hai-Ming Cao[2,*], Bi-Cheng Yang[1], Yong Gao[3], Li Ding[4], Peng Luo[3], Guang-Wen Yang[5], Lin Ma[6], Chun-Hua Deng[1]

Many therapies are effective in treating varicoceles, including dilation of the pampiniform plexus in males. The most common method of treatment is varicocelectomy. We aimed to assess an alternative technique (microsurgical spermatic [distal end]-superficial or inferior epigastric vein anastomosis) that preserves the normal blood flow pattern for varicocele treatment. We retrospectively analyzed 27 men with varicocele between October 2019 and July 2020. All patients underwent microsurgical spermatic (distal end)-superficial or inferior epigastric vein anastomosis. The prognosis was reviewed retrospectively with an additional survey conducted 3 months after surgery. The mean ± standard deviation of the age was 26.1 ± 7.3 years in patients with microsurgical spermatic (distal end)-superficial or inferior epigastric vein anastomosis. The maximum diameter of the varicocele vein, perineal pain score, sperm density, and forward movement of sperm improved over 3 months after surgery. Microsurgical spermatic (distal end)-superficial or inferior epigastric vein anastomosis is a safe and efficient surgical treatment for varicoceles.

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INTRODUCTION

Infertility in men is most commonly caused by varicoceles, which are abnormal dilations of the pampiniform venous plexus that are most commonly corrected by surgery[1–4]. Varicocele is common in 15% to 20% of the general population, in 21% to 40% of men with primary infertility, and 75% to 81% of men with secondary infertility[2,4,5]. The incidence of varicocele is less than 1% in preadolescent boys aged 2–10 years but increases to approximately 14% in adolescents aged 15–19 years[6].

There is the possibility that varicoceles can cause testicular damage, leading to loss of testicular volume, spermatogenic dysfunction, disruption of hormone production, and damaged sperm DNA in certain patients[1,7,8]. Many surgical techniques for varicoceles include microsurgical varicocelectomy, open varicocelectomy, laparoscopic varicocelectomy, and percutaneous varicocele embolization. The optimal method to treat varicocele is microsurgical subinguinal varicocelectomy (MSV) because hydrocele formation and varicocele recurrence occur at the lowest rates following this procedure[9–12]. Laparoscopic approaches are more likely than MSV to result in both recurrences and hydroceles. According to certain studies, laparoscopic varicocelectomy postoperative recurrence and hydrocele rates vary from 3% to 6% and from 7% to 43%, respectively[13,14]. One advantage of varicocele embolization is no risk of hydrocele formation after surgery because lymphatics are entirely untouched by surgery. In contrast, the recurrence rates of microsurgical varicocelectomy are significantly lower in the published literature[15–17].

However, the concept of devascularization is currently used in these surgical techniques for varicoceles. Here, we applied a conceptual shift from blocking to unblocking to create microsurgical spermatic (distal end)-superficial or inferior epigastric vein anastomoses in varicoceles.

PATIENTS AND METHODS

Patients

From October 2019 to July 2020, 27 consecutive men with varicoceles were evaluated for varicocele repair. The study was approved by The

[1]The Andrology Department, The First Affiliated Hospital, Sun Yat-sen University, Guangzhou 510080, China; [2]The Andrology Department, The Reproductive Medicine Center, The Seventh Affiliated Hospital, Sun Yat-sen University, Shenzhen 518107, China; [3]The Reproductive Medicine Center, The Key Laboratory for Reproductive Medicine of Guangdong Province, The First Affiliated Hospital, Sun Yat-sen University, Guangzhou 510080, China; [4]The Pathology Department, The First Affiliated Hospital, Sun Yat-sen University, Guangzhou 510080, China; [5]The Urology Department, Tongren Municipal People's Hospital, Tongren 554399, China; [6]The Reproductive Medicine Center, The Seventh Affiliated Hospital, Sun Yat-sen University, Shenzhen 518107, China.
Correspondence: Dr. L Ma (malin8@mail.sysu.edu.cn) or Dr. CH Deng (dch0313@163.com)
*These authors contributed equally to this work.
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Ethics Committee of Clinical Research and Medical Technology of The First Affiliated Hospital, Sun Yat-sen University, Guangzhou, China. Informed consent of these patients was obtained in this study. Semen was evaluated by computer-aided semen analysis (CASA). Physical examination and Doppler ultrasonography (Mindray, Shenzhen, China) were performed on all patients. There are many kinds of grading methods for varicocele. One of them is classified by physical examination as grades 1–3;[18,19] grade 1: the spermatic veins have no abnormality in scrotal palpation and only could be touched when the abdominal pressure increases; grade 2: the varicose spermatic veins could be touched at rest, but could not be seen; and grade 3: the varicose spermatic veins could be seen. Subclinical varicoceles are only diagnosed by image examination and cannot be seen or touched. After the varicocele operation, we followed up with some patients through physical examination and Doppler ultrasonography over 3 months after microsurgical varicocelectomy. The visual analog scale (VAS) score of perineal pain was also obtained before and after surgery.

Microsurgical technique

The indication for the surgical technique was as follows: patients diagnosed with varicoceles of a clinical type with symptoms of perineal discomfort. The exclusion criteria were as follows: (1) any of the following pelvic-related histories (pelvic operation, pelvic radiotherapy, or pelvic trauma); (2) varicose veins other than varicoceles; (3) perineal skin disease; or (4) surgical contraindications.

Under spinal anesthesia or general anesthesia, every patient was performed an oblique incision at the anti-McBurney's point of the varicocele side. Over the operating field, an operating microscope was placed (OPMI PENTERO 800, Zeiss, Jena, Germany). There was no damage to the testicular arteries and lymphatic vessels under microscope amplification (×8–×10). Only the largest spermatic vein was reserved and the rest were ligated (approximately 2–3 branches) with 5-0 silk. Similarly, if a superficial epigastric vein similar to the largest spermatic vein was fully dissociated, we selected it; if we did not find the appropriate superficial epigastric vein, we also looked for the inferior epigastric vein near the internal inguinal ring. The epigastric artery was severed from the superficial epigastric vein, which was similar to the largest spermatic vein. The superficial or inferior epigastric vein selected was preserved. Spermatic veins and superficial or inferior epigastric veins were separated, respectively. Then, the two vessels to be anastomosed were blocked with vascular clamps. The broken end vascular lumen was rinsed with normal saline and heparin in a 1000:1 mixed solution. The magnification of the microscope was adjusted to the appropriate level. Then, the end-to-end vein anastomosis (7-0 Prolene line) between the spermatic vein and the superficial or inferior epigastric vein was performed. Suture reinforcement was conducted as appropriate. The vascular clamps were loosened after anastomosis, and the anastomotic site was checked to rule out obvious leakage.

The surgical technique is outlined in **Figure 1** and **2**, and is different from another kind of surgical technology for varicoceles caused by nutcracker syndrome[20].

Statistical analyses

In this study, we used a paired test to determine whether several factors were significantly associated between the preoperative and postoperative periods (*e.g.*, the score of perineal pain, the size of the dilated veins, sperm density, and forward movement sperm). The count data were analyzed by paired *t*-test and the ranking data were analyzed by paired rank-sum test. Two-sided $P < 0.05$ was considered statistically significant. To carry out the statistical study, R software version 4.0 (Free Software Foundation, Inc., Boston, MA, USA) for MACOS version 11.6 (Apple Inc., Cupertino, CA, USA) was used.

RESULTS

Twenty-seven patients underwent microsurgical spermatic-superficial or inferior epigastric vein anastomosis. The patients' age (mean ± standard deviation [s.d.]) was 26.1 ± 7.3 years. We found that the size of dilated veins (maximal venous diameter) was significantly reduced in 25 of the 27 patients. The size of dilated veins (mean ± s.d.) was reduced from 2.8 ± 0.6 mm before the operation to 2.2 ± 0.3 mm after the operation. In two patients, there was no statistically significant change in the size of dilated veins, but the reflux disappeared. The VAS score of perineal pain, sperm density, and forward movement sperm were improved postoperatively compared with the preoperative values (**Table 1**). There was no statistically significant change in total testosterone levels before and after the operation (**Table 1**).

DISCUSSION

The varicocele is clinically defined as abnormally dilated and tortuous veins in the spermatic cord. Varicoceles are graded according to palpation and ultrasound examination. Regarding its anatomical factors, a varicocele is more commonly present on the left side because the spermatic vein drains into the renal vein in a perpendicular direction and has congenitally weak vein walls[21]. Outcomes of a varicocele consist of pain and problems associated with infertility. In men with varicoceles, pain associated with varicose veins is fairly common, occurring in 2% to 10% of these individuals[22]. The discomfort is commonly described as an exacerbated dull throbbing pain, especially after assuming an upright activity. It is rare for conservative treatment alone to successfully treat pain from varicoceles[23]. Male infertility is most commonly associated with varicoceles, which are easily correctable[24]. Varicoceles have been associated with poor-quality sperm in over half a century of research[25,26]. A case report published by Tulloch[27] in 1952 provided the first evidence that varicoceles are related to infertility.

Varicocelectomy ligates abnormally dilated veins, while preserving the spermatic artery and lymphatic vessels through many surgical approaches (*e.g.*, open, laparoscopic, loupe, robot-assisted, and microsurgical approaches). The standard treatment for varicocele is microsurgical varicocelectomy, according to a large meta-analysis published in 2009. In comparison with other surgical approaches, it had

Table 1: Subgroup analysis of spermatic-superficial epigastric vein anastomosis

Variable	*Preoperation*	*Postoperation*	*Paired P value*
Patients (*n*)	27	27	
Pain VAS score, *n* (%)			<0.001
0	8 (29.6)	16 (59.3)	
1	8 (29.6)	8 (29.6)	
2	7 (25.9)	3 (11.1)	
3	4 (14.8)	0 (0)	
Size of dilated veins (mm), mean±s.d.	2.8±0.6	2.2±0.3	<0.001
TT (ng ml^{-1}), mean±s.d.	4.8±2.4	4.0±0.2	0.07
Sperm density (×10^6 ml^{-1}), mean±s.d.	36.6±41.9	42.6±41.5	0.03
Forward movement sperm (μm s^{-1}), mean±s.d.	22.0±15.3	27.1±14.3	0.003

TT: total testosterone; s.d.: standard deviation; VAS: visual analog scale

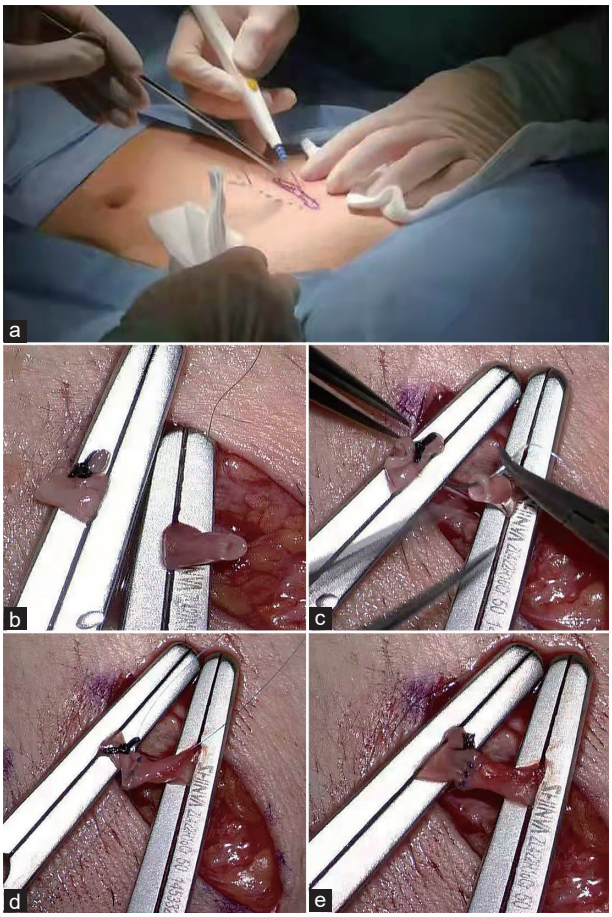

Figure 1: Flowchart of essential microsurgical techniques for varicoceles. (**a**) With a left inferior abdominal oblique incision (approximately 4 cm in length), the skin, subcutaneous tissue, and external oblique fascia were sequentially slit. (**b**) The largest spermatic vein was dissociated fully and the others were ligated. A relatively clear inferior or superficial epigastric veins were dissected. Then one epigastric vein that was similar to the largest spermatic vein was followed by cutting and end ligation. Next, the two vessels would be blocked by the vascular clamp. The broken ends of the vascular lumen were rinsed with normal saline and heparin in a 1000:1 mixed solution. (**c**) An appropriate magnification of the microscope was adjusted. Then the end-to-end anastomosis of the spermatic vein and epigastric vein was performed with a 7-0 Prolene line. (**d**) Generally, the two ends could be anastomosed with 6–8 stitches. (**e**) The suture was reinforced as appropriate. The vascular clamps were loosened after anastomosis and the anastomotic site was checked to rule out obvious leakage.

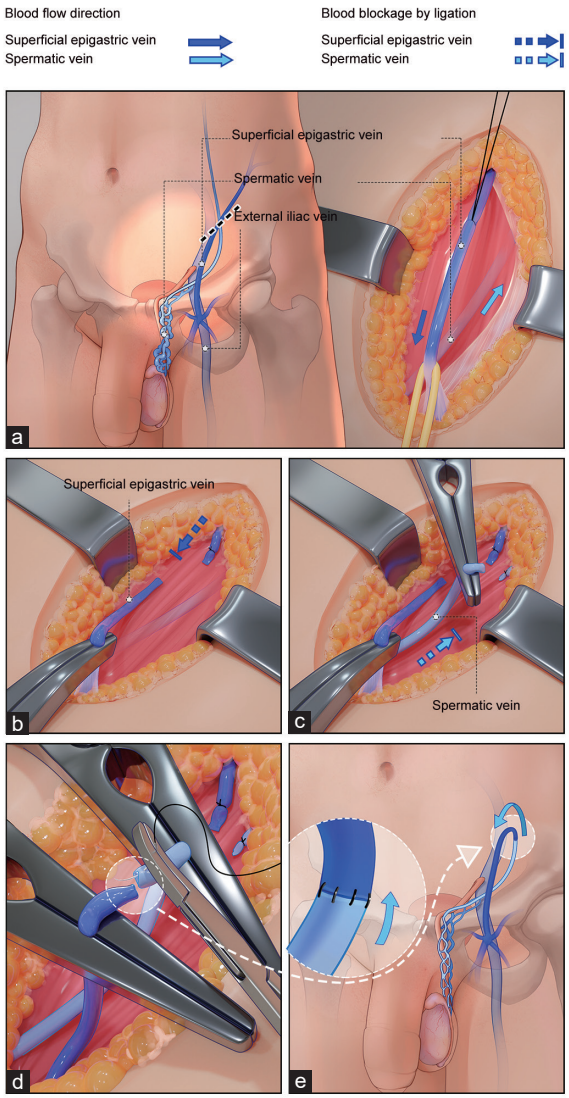

Figure 2: In the surgical method we designed, an end-to-end anastomosis is performed between the proximal end of the superficial or inferior epigastric vein and the distal end of the spermatic vein, while the spermatic artery and lymphatic vessel are both spared. (**a**) An oblique incision was made at the left anti-McBurney point. The superficial epigastric vein was fully dissociated. Its distal stump was ligated. (**b**) The proximal stump of the superficial epigastric vein was blocked by a vascular clamp. (**c**) The spermatic cord was dissociated. Spermatic veins (approximately 2–3 branches) were made by ligating the veins with 5-0 silk, with only the largest vein remaining. (**d**) The end-to-end anastomosis of the spermatic vein and superficial epigastric vein was performed with a 7-0 Prolene line. (**e**) Postoperative spermatic vein drained into the femoral vein through the superficial epigastric vein.

the lowest incidence of postoperative complications and the lowest rate of recurrence[28]. In the 1970s, the first report of retrograde embolization of a varicocele was published[29]. Compared with laparoscopic and open surgery, it is less invasive and has a higher failure rate[30–32]. To identify all spermatic cord structures during varicocele repair, optical magnification should be used[21]. To prevent varicocele recurrence, it appears vital to ligate all spermatic veins. However, dealing with the pampiniform plexus around the inguinal region easily disturbs the arterial and lymphatic channels, which results in hydrocele and even orchiatrophy.

Microscopic varicocelectomy returns to the "dangerous" area – the spermatic cord craniform plexus above and below the inguinal ring. Testicular arteries, lymphatic vessels, and nerve endings converge in this area and are also prone to injury or ligation. In the process of dissociating veins in the pampiniform plexus, the cremaster, which is the physiological-reflex structure of the spermatic veins, was damaged.

According to studies in the literature, varicocele and venous diseases are closely related[33,34]. Therefore, it is likely that venous pathology plays a role in the etiopathogenesis of varicocele[35]. In China, as the proverb goes, "King Yu combated the flood from congestion to dredging". Based on the anatomic association[33], we wanted to know whether the surgical method we designed brings more benefits to patients. Nahoum[34] reported anatomic associations between varicoceles and dilatation of Santorini's periprostatic plexus. In the surgical method we designed, an end-to-end anastomosis was performed between the proximal end of the superficial or inferior epigastric vein and the distal end of the spermatic vein, while the spermatic artery and lymphatic

vessel were both spared. The recurrence of varicocele was decreased with minimal operation risks, pain, and complications. However, varicocele associated with nutcracker syndrome may be treated with microsurgical left spermatic-inferior epigastric vein anastomosis, of which the main purpose is to ligate the varicocele (no drainage of the spermatic vein), drain the renal vein, and lower the renal venous pressure.

For our surgery, the internal spermatic vein is connected to the superficial epigastric vein (branches of the femoral vein) or inferior epigastric vein (the external iliac vein) to reconstruct a channel that can dredge the testicular blood flow promptly and eventually enter the inferior vena cava. This could not only block reflux of the spermatic vein (in view of the pathogenesis) and restore the venous return of the testis promptly, but also avoid surgery in the "dangerous" zone of the spermatic cord vine vascular plexus, while also preventing damage to important structures such as the cremaster, testicular artery, nerves, and lymphatic vessels.

As a limitation, our study population is not fully representative of the entire population because our analysis is based on the characteristics of patients in a single center. Another limitation of the study was the short follow-up period; a longer follow-up might yield different results. Therefore, a prospective study is needed to confirm such an association.

AUTHOR CONTRIBUTIONS

CHD and LM conceived and designed the study. ZW, HMC, BCY, YG, LD, PL, and GWY recruited the participants and collected data. HMC and ZW wrote and revised the manuscript. CHD, LM, ZW, and HMC edited the manuscript and provided comments and feedback. CHD and LM supervised the study. All authors read and approved the final manuscript.

COMPETING INTERESTS

All authors declare no competing interests.

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